Appendix: Argonne in an Integrated DOE Laboratory System

Table A.1 describes some of Argonne's more notable direct collaborations with other DOE laboratories. Brief summary descriptions in the table focus on the way effective collaboration is achieved. Not included are detailed discussions of the value of the research and of which laboratory does which tasks. The table also does not describe the many routine ways in which DOE laboratories cooperate, as when one laboratory simply provides technical services to another on the basis of its special capabilities. Omitted as well are major Argonne R&D collaborations that involve only partners outside the DOE laboratory system, though many of the included collaborations do, as noted, extend outside the system to universities and industrial firms.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
SCIENCE				
Spallation Neutron Source construction project, supported by the DOE Office of Basic Energy Sciences (BES). Design and construct a new accelerator-based facility providing the world's most intense pulsed neutron beams for scientific and industrial R&D. The total project cost of this facility, which is being built at Oak Ridge National Laboratory, is $1.41 billion.	Brookhaven, Lawrence Berkeley, Oak Ridge, Los Alamos. Jefferson Lab. The neutron user community, including universities and industrial firms, plays a key advisory role.	$291 million	As a group, advise DOE on program directions through the Basic Energy Sciences Advisory Committee. Jointly recommend particular project elements to DOE. Meet approximately every six weeks for in-depth technical coordination on the entire facility construction project.	A new collaborative approach to designing and constructing a major DOE research facility, intended to be a model for future facilities. Each collaborating laboratory is responsible for integrating a major component — ion source, linac, accumulator ring, target, or instrumentation — into the final facility. In addition to taking advantage of each laboratory's distinctive strengths during construction, the new approach will facilitate the eventual shift at the Oak Ridge site to an operations staff with appropriate skills.
Linac Coherent Light Source (LCLS) Research Collaboration, supported by the BES Division of Materials Sciences — at Argonne through the Advanced Photon Source. The collaboration will conduct R&D preparatory to construction of the LCLS, the first free-electron laser test facility in the hard X-ray spectral range. The ultimate goal is the concept for a fourth-generation light source user facility capable of performance greater by many orders of magnitude than that of today's third-generation sources.	Brookhaven, Lawrence Livermore, Los Alamos, Stanford Linear Accelerator. University of California at Los Angeles.	$1.5 million	Jointly advise DOE on overall program directions. Coordinate to select complementary research activities, subject to DOE approval. Achieve technical coordination across organizations through a quarterly meeting, plus frequent communication between individual investigators as needed.	The LCLS Research Collaboration will lay the groundwork for future cooperation among DOE laboratories in developing new synchrotron radiation facilities, including eventually the fourth-generation light source.
Isolated and Collective Phenomena in Nanocomposite Magnets, a technical project within the DOE Center of Excellence for the Synthesis and Processing of Advanced Materials, which was established by the BES Division of Materials Sciences, in partnership with the DOE laboratories. The goal is improved materials for permanent magnets through improved understanding of the relationship between microstructure and magnetic properties.	Brookhaven, Lawrence Berkeley, Oak Ridge, Idaho Engineering and Environmental, Los Alamos. Ames Laboratory. Industrial manufacturers of permanent magnets.	Approximately $3 million for the Center of Excellence for the Synthesis and Processing of Advanced Materials	Coordinate to establish appropriate research areas. Mutually select technical approaches that best exploit and integrate the distinctive capabilities of the laboratory partners. Communicate all useful information quickly. Exchange experimental samples for characterization by techniques available at partner laboratories.	The DOE Center of Excellence for the Synthesis and Processing of Advanced Materials was designed specifically as a distributed organization dedicated to promoting a limited number of coordinated, cooperative, multilaboratory research partnerships related to the synthesis and processing of advanced materials for energy technologies. After a finite life of five years within the center, a project is expected to have an established research agenda and associated collaborations and to become a normal DOE program that does not require such intense nurturing. DOE laboratory coordinators for the center's various projects have major input into long-run directions for the center, along with an industry steering group that also helps to review ongoing projects.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Microstructural Effects on Mechanics of Materials, a project within the DOE Computational Materials Science Network, established by the BES Division of Materials Sciences, in partnership with the DOE laboratories. Elucidate and improve the mechanical properties of polycrystalline materials through improved understanding of the way dislocations interact with grain boundaries during deformation.	Lawrence Berkeley, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, Sandia. National Institute of Standards and Technology. MIT, University of Pennsylvania, University of California at Berkeley, Carnegie-Mellon University.	Approximately $1.1 million	Coordinate to establish appropriate joint research areas involving large-scale, massively parallel computer simulations. Mutually develop and select computer simulation approaches that best exploit and integrate the distinctive capabilities of the partner laboratories. Share all useful information quickly.	The DOE Computational Materials Science Network was designed specifically as a distributed research organization dedicated to promoting closely coordinated, cooperative multilaboratory projects involving large-scale, massively parallel computer simulations of advanced materials. Multilaboratory collaborations are at the heart of the network's strategy for developing new computational approaches to solving important, technologically relevant materials problems.
Granular Flow and Kinetics, funded under the Center of Excellence for the Synthesis and Processing of Advanced Materials by the BES Division of Materials Sciences. Experimentally and theoretically examine the dynamic behavior (e.g., jamming, mixing, segregation, fluidization) of granular media, a very important category of material used extensively by industries such as pharmaceuticals, agriculture, mining, and construction.	Los Alamos, Sandia. Ames. Five universities.	$3.0 million	Share facilities and expertise to develop comprehensive, synergistic investigations of a broad range of phenomena in granular media, with various partners bringing special capabilities in simulation and modeling, electrostatic fluidization, novel particle-tracking techniques, laboratory-scale fluidized beds, and granular avalanche analysis. Coordinate for the shorter term by conference call every two weeks, for the longer term at an annual workshop.	The DOE Center of Excellence for the Synthesis and Processing of Advanced Materials aims specifically at implementing collaborations that bring to bear complementary capabilities across the DOE laboratory system, in cooperation with university partners.
Development of high-gradient superconducting accelerating structure technology for high energy physics and fourth-generation light sources, a collaboration stemming from a larger technology development collaboration centered at Germany's Deutsche Elektronen Synchrotron (DESY). Supported by the Office of Science. The two DOE laboratories in Illinois plan to share the infrastructure required to adapt the DESY technology to their respective specialized interests and ultimately to serve other applications across the DOE system.	Fermilab. (Roughly 40 institutions worldwide participate in the large DESY-centered collaboration, including Argonne, Fermilab, and two U.S. universities.)	Argonne participation supported by Laboratory-directed resources at this early stage	Advise DOE jointly on general issues and individually on applications (Fermilab for high energy physics, Argonne for fourth-generation light sources). Meet weekly for scientific and engineering discussions and monthly for longer-term planning of the substantial new infrastructure needed.	The long-run objective is to develop for the entire DOE laboratory system a coordinated capability in superconducting accelerator technology that will rely on collaboration with other DOE laboratories as its standard mode of operation.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
U.S. participation in development of the *ATLAS detector for the Large Hadron Collider (LHC)* to be built at the CERN laboratory in Switzerland. U.S. participation is funded by DOE's High Energy Physics Division and by the National Science Foundation (NSF). By observing particle collisions at energies seven times greater than previously possible, investigate major physics questions such as the mechanism for electroweak symmetry breaking.	Brookhaven, Lawrence Berkeley. Approximately 25 universities.	$25 million	With university partners, advise DOE as a group through the ATLAS Executive Committee. Coordinate to develop mutually complementary detector components, subject to DOE approval.	This collaboration is notable for including large numbers of institutional and close individual collaborators (even for high energy physics), provision of sizable funding through both DOE and the National Science Foundation (NSF), and an absolute constraint imposed by Congress on total U.S. funding for ATLAS and a second LHC detector. DOE and NSF coordinate funding and management through an innovative joint oversight group to which the DOE laboratories have input through the two detector collaborations. Two levels of contingency funds cushion the absolute U.S. funding cap.
The *MINOS detector* for long-baseline neutrino oscillations, supported by DOE's High Energy Physics Division. Located in a mine in Minnesota, the detector will receive neutrinos emitted from Fermilab in Illinois after they have traveled 730 kilometers underground.	Fermilab. Several universities.	$15 million	Select mutually complementary technical approaches, subject to DOE approval. Coordinate closely on day-to-day research activities, often through an R&D task team with members from the two DOE laboratories and from universities.	Of modest size for high energy physics, this collaboration illustrates the effective functioning of procedures that have been refined over many years as the numbers of participants in detector collaborations have increased.
Collider Detector at Fermilab (CDF), supported by DOE's High Energy Physics Division. The original high-transverse-momentum detector at the Tevatron collider is used to study particle production and dynamics at the world's highest collider energy, including the production of top and bottom quarks and possibly electroweak symmetry breaking.	Fermilab, Lawrence Berkeley. Several U.S. universities and research groups from Italy and Japan.	Approximately $10 million	Collaborate in CDF upgrading under overall Fermilab leadership. Share in or undertake individually a broad range of tasks, including design, tooling, and task management, with many participating physicists spending a substantial fraction of their time at Fermilab.	This project pioneered many of the now-accepted operational modes for international detector collaborations involving hundreds of high energy physicists. Distinct project construction and operations organizations, responsible for meeting budgets and schedules, are in creative tension with a collaboration organization focused on physics requirements, detector performance, and analysis and publication of results. Atop the physics collaboration is a governing council of institutional representatives that organizes four or five analysis groups for different areas of physics, within which researchers coordinate (e.g., share analysis techniques and prevent overconcentration on popular topics) and review one another's work. The council decides global questions such as collaboration membership and optimization of running conditions for one investigation rather than another.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Operation of *Gammasphere*, supported by DOE's Nuclear Physics Division. The world's most powerful gamma-ray detector for studying the structure of atomic nuclei, Gammasphere has been operated successfully at both Lawrence Berkeley and Argonne. Gammasphere is expected to return to Argonne in FY 2003.	Lawrence Berkeley and other national laboratories.	$800,000	Within a collaboration of 21 institutions, designed, constructed, and tested the $23 million Gammasphere. Operate the detector (first at Lawrence Berkeley, then at Argonne, and now back at Berkeley) to take advantage of unique complementary accelerator facilities available at each site. Coordinate closely on the very complicated dismantling, moving, and reassembly. Contribute collaborators to many outside experimental teams using Gammasphere. Advise DOE on future directions through the DOE-NSF Nuclear Science Advisory Committee, joint program advisory committees, and other avenues.	The harmonious, efficient relocation of Gammasphere illustrates one way that national laboratories work together effectively as part of a larger system. A current focus is planning and performing R&D for a next-generation gamma detector for tracking gamma interactions.
Research aimed at developing *a rare isotope accelerator facility* to provide intense beams of short-lived, unstable (radioactive) nuclei for research in nuclear physics and related fields. To be supported by DOE's Nuclear Physics Division.	Lawrence Berkeley, Oak Ridge, Lawrence Livermore, Los Alamos. Jefferson Lab. Michigan State University.	$2.8 million	Coordinate concepts for various components of the new accelerator facility. Advise DOE jointly on future directions through the DOE-NSF Nuclear Science Advisory Committee, various program advisory committees, and other avenues. Coordinate among bench scientists each year through a national committee meeting and several less formal meetings.	A formal national committee of the collaborative partners advises DOE in detail regarding resource allocation.
Advanced collaboration and software components technology research, supported by the Mathematical, Information, and Computational Sciences Division. Design new mechanisms, interfaces, and modules that enable flexible interoperability of tool kits, codes, and advanced computing resources for mission-critical DOE problems.	Various projects involve Lawrence Berkeley, Oak Ridge, Lawrence Livermore, Los Alamos, and Sandia. University of Southern California. Aerospace Corp.	$950,000 (for Argonne only)	As a group, advise DOE on long-run program directions.	Various elements of these projects — such as developing interfaces between computational tool kits originating at different laboratories, exploring component-based approaches to large-scale optimization, using numerical kernels to enable code reuse, and creating functionality to support experiments in networked computing — clearly will facilitate future collaboration across DOE sites.
Fusion Energy Sciences. Acquire the knowledge base needed for an economically and environmentally attractive fusion energy source.	Oak Ridge, Pacific Northwest, Sandia. Princeton Plasma Physics Laboratory. University of Illinois, University of Wisconsin, University of California at Los Angeles, University of California at San Diego. General Atomics.	Approximately $250 million	Advise DOE on long-run program directions via steering committees. Selectively propose projects jointly to DOE. Coordinate with one another and with university and industrial partners through telephone conferences every week or two and through major annual meetings.	The Virtual Laboratory for Technology within the fusion community facilitates the coordination and review of programs. Video conferencing to replace formal meetings is being developed.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Atmospheric Radiation Measurement (ARM) Program, supported by DOE's Environmental Sciences Division. In order to better understand global and regional climate change, teams of scientists gather field measurements at several diverse sites around the world and develop models of the processes that control solar and thermal infrared radiative transfer in the atmosphere.	Brookhaven, Lawrence Berkeley, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, Sandia. National Renewable Energy Laboratory. Also 7 other government organizations, 5 private companies, 12 international organizations, 20 universities.	$40 million	Participate in science team research, including collaborations with researchers from many organizations. Beyond science team projects selected by formal peer review, advise DOE jointly on program directions through the ARM Management Team. Collaborate daily with other scientists on various functional teams and in various site management offices. Coordinate the participation of other R&D partners, especially in connection with field observations and the analysis of collaborative experiments.	A remarkably diverse collaboration, in terms of geographic dispersion, as well as numbers and types of organizations. The collaboration is pursuing methods of data management and information exchange via the Internet that will facilitate future interlaboratory integration.
Atmospheric Chemistry Program, supported by the Environmental Sciences Division. Advance information about the atmospheric environment, especially regional and continental chemistry and the fate of tropospheric trace chemicals related to energy production; conduct laboratory studies, theoretical investigations, numerical modeling, and collaborative field campaigns.	Brookhaven, Lawrence Berkeley, Pacific Northwest, Lawrence Livermore. One other federal agency, 12 universities.	$6.5 million	Participate in various projects selected by peer review and closely coordinate their execution, especially through one to four collaborative field experimental campaigns conducted each year. Advise DOE jointly or individually. Meet within special-interest groups of program participants two or three times each year.	Joint fieldwork features use of the Battelle G-1 research aircraft. The program's web site, in addition to research project descriptions, will provide data sets and codes for numerical atmospheric models.
Water Cycle Pilot Study and Initiative, supported by the Environmental Sciences Division. Demonstrate the feasibility of evaluating the components of the hydrologic water cycle by using field observations (at the Walnut River Watershed in Kansas), application of techniques such as analysis of oxygen and hydrogen isotopes in water, and development of atmospheric and belowground hydrologic models.	Brookhaven, Lawrence Berkeley, Oak Ridge, Los Alamos. University partners are anticipated.	$1.5 million (for the pilot study only)	Advise DOE jointly but informally. Coordinate to select mutually complementary projects, subject to DOE approval. Hold formal meetings annually, informal technical coordination meetings approximately quarterly, and teleconferences as needed. Often collaborate daily, for example in fieldwork.	Interlaboratory collaboration will be particularly close where field measurements serve the common research needs of multiple partners. A framework will be developed by the partners for integrating numerical modeling.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Center for Research on Carbon Sequestration in Terrestrial Ecosystems (CSiTE), supported by DOE's Environmental Sciences Division. Perform fundamental research that will lead to acceptable methods for enhancing carbon sequestration in terrestrial ecosystems as one component of a carbon management strategy. Develop (1) scientific understanding of carbon capture and sequestration mechanisms in terrestrial ecosystems across multiple scales, from the molecular to the landscape; (2) conceptual and simulation models for extrapolating understanding of processes across spatial and temporal scales; (3) estimates of the national potential for carbon sequestration; and (4) assessments of environmental and economic impacts from sequestration.	Oak Ridge, Pacific Northwest. Six universities, one international research institute, and four research organizations within the U.S. Department of Agriculture.	Approximately $2 million	Participate in science team research tasks, including collaboration across institutions. Coordinate administrative and budgetary direction. Through a principal scientist at each national laboratory, provide scientific direction and coordination. Informally advise DOE, jointly or individually. Hold formal coordination or review meetings annually, informal meetings and conference calls more frequently. Collaborate with individual researchers and small groups most often, especially at field sites and in modeling efforts.	CSiTE studies are conducted at multiple scales at common sites. Special sessions at joint meetings are forums for dissemination of information and planning for integrative papers for general-interest scientific journals. The national laboratories and other research partners are planning workshops to examine the feasibility and consequences of various carbon sequestration scenarios, as well as to help focus future research.
NUCLEAR ENERGY, SCIENCE AND TECHNOLOGY				
Nuclear Reactor Technology Lead Laboratories, supported by the Office of Nuclear Energy, Science and Technology. Prepare a technology road map to guide development of next-generation (Generation IV) nuclear energy systems; maintain the staff, facilities, and knowledge base required for future U.S. R&D on advanced nuclear reactors.	Idaho Engineering and Environmental (primary partner); Brookhaven, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, and Sandia (participants in development of the Generation IV technology road map).	$4 million	Advise DOE jointly on the full range of R&D needed to support the future of civilian nuclear power. Hold joint in-depth technical coordination meetings at least once a week. Undertake less formal technical coordination more frequently, often daily.	The two primary partners jointly evaluate new reactor technologies. They organize and host a wide variety of meetings on technical issues, including international forums.
ENERGY EFFICIENCY AND RENEWABLE ENERGY				
High-Temperature Superconducting (HTS) Wire Development, three coordinated cooperative R&D agreements supported by the Office of Electric Energy Systems and Storage. Development and fabrication of novel HTS conductors for electric power systems.	Los Alamos. University of Wisconsin at Madison. American Superconductor.	$500,000 (for the DOE laboratories only)	Advise DOE jointly regarding long-run program directions through the Wire Development Group, a formally constituted advisory body with broader responsibilities that meets every four months. Coordinate to select complementary research projects and responsibilities, under the leadership of American Superconductor and subject to DOE approval. Use monthly teleconferences and numerous intervening communications among researchers for immediate technical coordination.	Synergy among the DOE laboratories most often involves preparation, characterization, and testing of HTS samples at multiple locations. The Wire Development Group has effectively fostered other important DOE interlaboratory collaborations. In 2000 it received the Collaboration Success Award from the Council for Chemical Research.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
"Industries of the Future" structuring of the Office of Industrial Technologies. A strategy for coordinating and facilitating R&D for energy-intensive materials and process industries, often through partnerships involving DOE laboratories.	All eight other DOE multiprogram national laboratories. National Renewable Energy Laboratory, Ames Laboratory, Federal Energy Technology Center, Savannah River Site, Y-12 Plant, Albany Research Center. Industry trade associations, professional societies, universities, other government agencies, and many industrial firms.	$149 million	Through the Laboratory Coordinating Council, meet and confer with industry and other potential partners, as well as with the DOE program office. Contribute to the industry-led, DOE-fostered process of creating R&D visions and road maps for seven major industry groups. Create broad R&D partnerships featuring industry cost sharing and often involving multiple DOE laboratories.	The Laboratory Coordinating Council is an important organizational innovation for developing exceptionally broad R&D partnerships between industry and the DOE laboratories, and beyond.
The *Advanced Technology Development program on advanced batteries for hybrid vehicles*, supported by the Office of Advanced Automotive Technologies. Develop high-power lithium-ion batteries, including the required new materials, processes, and diagnostic techniques.	Brookhaven, Lawrence Berkeley, Idaho Engineering and Environmental, Sandia. Army Research Laboratory. Three universities. Six corporations.	$7 million	Advise DOE jointly on critical technical barriers to battery development and on long-term R&D needs. Coordinate to select areas of responsibility and complementary research projects, subject to DOE approval. Share results via quarterly two-day coordination meetings, monthly highlight reports, and postings on linked web sites.	Collaboration among laboratories is being facilitated by the development of standardized procedures for battery testing and reporting of results.
ENVIRONMENTAL MANAGEMENT				
Three projects for the *Environmental Management Science Program* (EMSP), which is jointly sponsored by the Office of Environmental Management and the Office of Science. Basic research aimed at much better technical solutions to DOE's environmental cleanup problems.	Pacific Northwest. Savannah River Site. Several universities.	$0.5 million for the projects involving Argonne	Provide broad advice to EMSP (and other Environmental Management programs) through the Strategic Laboratory Council, which includes one representative from each DOE laboratory and facilitates information exchange across institutions, as well as assisting EMSP in other ways, such as organizing joint conferences and workshops. Among R&D partner bench scientists, coordinate once or twice a month.	EMSP is a premier case of integration across sponsoring offices at DOE. Extensive collaboration among EMSP R&D partners is a core strategy, is explicitly encouraged by the program's proposal process, and is increasingly being implemented. An information network exploiting the Internet and other tools helps EMSP researchers communicate and collaborate beyond the program, with technology developers, managers of sites with environmental problems, regulators, and others. National workshops are held with potential DOE users of EMSP technologies.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Environmental Management programs (other than EMSP, described above). Environmental restoration, waste management, and associated technology development (including R&D, demonstration, testing, and evaluation projects) for DOE sites.	The multiprogram national laboratories. Ames Laboratory, Environmental Measurements Laboratory, Rocky Flats Environmental Technology Site, Savannah River Site. Many industrial firms and universities.	Approximately $7 million for Argonne alone, including R&D, technical support activities, and actual cleanup	Often advise DOE jointly on appropriate technical approaches, though the majority of R&D projects are selected by a straightforward process of proposals from individual laboratories. Through the Strategic Laboratory Council (as described above for EMSP), advise DOE on long-run R&D directions, program reviews and improvements, and strategic planning, including road maps. Among R&D partner bench scientists, coordinate weekly to monthly.	Technology demonstration projects are often very large in scale and accomplish major programmatic objectives in themselves. The demonstrations give an unusually wide range of technology providers and other collaborators the opportunity to prove themselves.
TechCon program, Office of Science and Technology. Provide technical assistance to private-sector waste management and environmental restoration project teams at DOE sites, for example by encouraging integration of commercial capabilities with emerging technologies.	Pacific Northwest. (Sandia coordinates the Innovative Treatment Remediation Demonstration program, which increasingly cooperates with TechCon.)	Approximately $0.5 million	Collaborate with DOE, site management private contractors, and subcontractors to identify opportunities to deploy superior remediation technologies to increase performance and reduce cleanup costs. Facilitate interactions among all parties, including stakeholders, helping to identify technology gaps and R&D needs.	TechCon employs (1) forums for multiple-site project vendors and (2) Internet project data gathering and interactions to reduce barriers to the implementation of innovative technologies, thereby achieving waste minimization, cost savings, performance improvement, and risk reduction. This unique mechanism assures integrated use of the best available environmental technologies for DOE site cleanups.
DEFENSE PROGRAMS				
Nuclear Criticality Safety Program, supported by Defense Programs, Environmental Management, and other DOE offices. Establish within DOE an improved and integrated capability to predict criticality in nuclear fission systems through new experiments, benchmarking against available U.S. and international data, refinement of three alternative Monte Carlo computer models used within DOE, and processing of nuclear data into standard working forms.	Oak Ridge, Idaho Engineering and Environmental, Lawrence Livermore, Los Alamos. Two universities.	Approximately $9 million	As a group, advise DOE on long-run program directions. Work together on tasks such as evaluation of nuclear data, coordinating informally at the bench scientist level approximately every two months. Coordinate quarterly and annually to choose mutually complementary projects, subject to DOE approval.	Resulting information and software will be distributed in standardized form by the DOE-wide code center and will be used easily by engineers throughout DOE and beyond. For example, the refined nuclear criticality computer codes will be incorporated easily into the various laboratories' existing software systems.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Message-passing interface component of the Software PathForwrd Program, supported by the Office of Defense Programs through the Accelerated Strategic Computing Initiative. Conduct research needed for implementation of the message-passing interfaces MPI-1 and MPI-2 on high-performance computers; develop new interfaces to exploit advanced networking, enable thread safety, improve input-output performance, and display multigigabyte log files.	Lawrence Livermore, Los Alamos, Sandia. Four software development firms.	$400,000 (for Argonne only)	To guide implementation of the standards, coordinate through formal meetings twice a year and less formal exchanges about once a month.	One project goal is development of a common message-passing interface standard for use on the high-performance computers of all DOE-Defense Programs laboratories and their research partners.
Scientific Discovery through Advanced Computing (SciDAC), supported by the Mathematical, Information, and Computational Sciences Division. Create a new generation of software and tools that will enable scientists to exploit terascale computers fully by undertaking projects including (1) development of mathematical and computing systems software to support scientific simulation and (2) collaboratory projects and middleware development to support collaboration using distributed resources.	Brookhaven, Lawrence Berkeley, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, Sandia. Fermilab, Jefferson Lab, Ames. General Atomics.	$6.2 million (for Argonne only)	Advise DOE as a group. Coordinate to select projects, subject to DOE approval. Coordinate regularly (though generally not day to day) on important issues such as reviewing authorization policies and protocols, testing new audio and visual technologies, developing consistent interfaces among software libraries, and analyzing problems experienced in transferring petabyte-scale data sets.	Coordination among SciDAC projects extensively uses the Access Grid, an ensemble of advanced resources for facilitating grid-based group-to-group (as opposed to desktop-to-desktop) communication. Feedback from this early use helps improve the Access Grid for a broad range of applications beyond research collaboration, including large-scale distributed meetings and distance education.
DEFENSE NUCLEAR NONPROLIFERATION				
International Nuclear Safety Program (not including the research-oriented International Nuclear Safety Center, discussed below). In cooperation with other Western industrialized countries and international agencies, conduct joint projects with nine former Soviet bloc countries hosting Soviet-designed nuclear reactors to help identify and correct major reactor safety deficiencies and establish a self-sustaining nuclear safety infrastructure.	Brookhaven, Pacific Northwest, Oak Ridge, Idaho Engineering and Environmental. Many U.S. engineering services and other companies.	$20 million	Coordinate and, within particular projects, participate either individually or as teams. Daily communication is typical among participating laboratories.	Special initiatives focus on reducing risks at the first generation of Soviet-designed reactors. Participation in projects goes beyond other DOE-sponsored research organizations to include the host country (Russia, Ukraine, Armenia, Bulgaria, Czech Republic, Hungary, Lithuania, Slovakia, or Kazakhstan). DOE laboratory collaborators make extensive use of technologies such as videoconferencing and the paperless office.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
International Nuclear Safety Center (INSC). For nuclear power engineering worldwide, promote the open exchange of safety information, cooperate in the development of safer technologies, and help collect and disseminate relevant information (particularly through a remotely accessible electronic database covering engineering information and results from safety analyses for U.S.-designed and Soviet-designed power plants and other nuclear facilities around the world).	Oak Ridge, Pacific Northwest, Idaho Engineering and Environmental. Other INSCs in Russia, Armenia, Lithuania, Kazakhstan, and Ukraine — and, through them, many additional research institutes.	$0.6 million	Coordinate with experts in other participating countries to establish joint nuclear safety research projects.	The U.S. INSC database and its counterparts at other INSCs include project results that are immediately accessible worldwide via the Internet. These online resources are very valuable in collaborations between countries.
Interior infrastructure preparedness component of the Chemical-Biological Nonproliferation Program, supported by the Office of Research and Development. Develop advanced technologies and technical services to help cities detect and counter the use of chemical or biological weapons by terrorists in subways, airports, high-threat buildings, and other places.	Lawrence Livermore, Los Alamos, Sandia. As this new program develops, partners will include engineering firms and emergency response organizations at all levels of government.	$1.9 million for the national laboratories	Advise DOE jointly on program directions, both informally and through a formal advisory group. Coordinate to choose mutually complementary projects, subject to approval by the DOE sponsor. Conduct joint R&D on topics such as simulating the impacts of chemical and biological releases.	Effective development and implementation of new technologies to address this complicated problem — such as detectors and computer models for predicting the transport and fate of chemical or biological agents — typically will require integration of expertise from multiple DOE laboratories and industry, plus close cooperation with city governments. Local transit authorities will cooperate in the program as appropriate and will support their own preparedness operations.
Initiatives for Proliferation Prevention, supported by the Office of Nonproliferation and International Security. Identify and develop commercial nonmilitary work for scientists and engineers involved in weapons programs (nuclear, chemical, and biological) in the former Soviet Union (FSU), particularly by involvement of U.S. companies in cooperative R&D through DOE laboratories and ultimately in commercial deployment of FSU technologies.	All eight other DOE multiprogram laboratories. National Renewable Energy Laboratory, Kansas City Plant.	$34 million	Through the Interlaboratory Advisory Board, advise DOE on long-run program directions, recommend desirable projects to DOE, and oversee the participation of U.S. businesses. Coordinate formally on technical issues every six months, less formally approximately weekly. Use a Lotus Notes database on the Internet to facilitate interlaboratory communication and informal program auditing by DOE.	Before involvement of U.S. companies, an R&D collaboration between a DOE laboratory and one or more FSU institutes is an opportunity to begin the education of FSU participants in intellectual property rights, entrepreneurship, and commercialization. To facilitate the collaborations, DOE has simplified project review processes and fostered implementation of uniform administrative procedures.
Nuclear Cities Initiative, supported by the Office of Nonproliferation and International Security. Identify and initiate commercial business opportunities that will employ former nuclear weapons workers in "closed" Russian cities, in order to help downsize the Russian nuclear weapons complex.	Lawrence Livermore, Los Alamos, Oak Ridge, Pacific Northwest, Sandia. (Initial negotiations have included many small businesses, as well as large companies such as Schlumberger and Motorola.)	$22 million (mostly passing through to Russian participants)	Advise DOE informally prior to project selection by DOE and project approval by the Russian Ministry of Atomic Energy (Minatom). Coordinate among laboratories through conference calls every two weeks and meetings twice a year.	Activities at each Russian city are coordinated by a lead DOE laboratory.

Table A.1 Argonne's Direct Collaborations with Other DOE Laboratories and Beyond (Cont.)

DOE Program	Argonne's R&D Partners — National Laboratories; Others	Total DOE Program Funding (FY 2002)	Joint Roles of DOE Laboratories	Collaboration Highlights and Innovations
Programs of Cooperation on Nuclear Material Protection, Control, and Accounting (MPC&A) between the United States and the successor states of the FSU, supported by the Office of International Material Protection and Emergency Cooperation and the Office of Arms Control and Nonproliferation. Cooperate with Russia and the independent states that process weapons-usable nuclear materials to strengthen site security and help develop MPC&A systems.	Brookhaven, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, Sandia. Nonproliferation and National Security Institute, New Brunswick Laboratory, Pantex, Savannah River Site.	$275 million (plus substantial carryover from FY 2001)	Through the MPC&A Advisory Panel, provide technical recommendations to DOE on program plans and on project scopes, staffings, and budgets. Participate on multilaboratory teams undertaking particular projects, typically coordinating on technical issues at least weekly with team members at other laboratories. Coordinate the participation of other organizations, including FSU research institutes and private companies.	A typical large MPC&A project involves a very diverse set of tasks, to which several DOE laboratories logically contribute on the basis of their established special capabilities. Final implementation is in Russia or the independent states.
BN-350 Shutdown Project, a project of the National Nuclear Security Agency (NNSA) Office of International Safety and Cooperation. Ensure irreversible shutdown of the breeder reactor in Aktau, Kazakhstan, in cooperation with local research organizations, regulators, and other authorities.	Pacific Northwest, Brookhaven. Department of State Nonproliferation and Disarmament Fund (NDF), Nuclear Regulatory Commission, International Science and Technology Center (ISTC).	$23 million (including NDF and ISTC funds)	Advise DOE jointly, as a group. Work toward harmonization of the tasks led by each laboratory. Provide technology, designs, and equipment in each laboratory's area of expertise. By electronic mail and telephone, coordinate daily on technical issues with partners at the other laboratories and in Kazakhstan.	The methods of communication used between technical experts in Kazakhstan and the United States are routine but effective, in part because similar backgrounds and interests foster a productive rapport.
International Cooperation on Nuclear Export Controls, supported by the Office of Export Control Policy and Cooperation. Help the FSU and other partner countries implement or improve effective systems for controlling the transfer of materials, equipment, and technology that could be used to produce nuclear weapons.	Oak Ridge, Lawrence Livermore, Los Alamos.	Approximately $3.0 million	As a group, make recommendations to NNSA on long-run program directions and particular projects to be undertaken. Coordinate the participation of technical institutes in the partner countries.	The program is implemented largely through cooperative agreements directly between DOE laboratories and nine technical institutes in the partner states. These arrangements have greatly facilitated identification and training of the technical experts needed by the government agencies administering nuclear export controls.
Highly Enriched Uranium Transparency Implementation Program, supported by the Office of Nonproliferation and National Security. In Russia, monitor the blending down of highly enriched uranium from dismantled nuclear weapons to produce low-enrichment uranium for use in commercial reactors.	Brookhaven, Oak Ridge, Pacific Northwest, Lawrence Livermore, Los Alamos, Sandia. DOE Remote Sensing Laboratory.	$14.0 million	Advise DOE regarding long-run program directions, both individually and jointly. Hold a formal joint meeting annually; coordinate among researchers typically once a month.	In the future, close interlaboratory coordination and technical collaboration are likely to be required for tasks such as development and implementation of new monitoring technologies.
The joint U.S.-Russian Materials Disposition Program, sponsored by the Office of Fissile Materials Disposition. Convert excess weapons plutonium into spent reactor fuel that is unsuitable for reuse in nuclear weapons.	Oak Ridge, Lawrence Livermore, Los Alamos. Russian research institutes.	$9 million for the DOE laboratories	Advise DOE about long-run program directions, jointly as a group but informally. Make joint recommendations on projects to NNSA, which makes the final selection.	To coordinate Russian contributions to evaluating the use of fast reactors for plutonium disposition, joint teams with members from Oak Ridge and Argonne visit the Russian research institutes.